Education on the Use of Black Cumin Seeds (*Nigella sativa*) on Metabolite Profiles, Compound Target Prediction, and Toxicity Testing in Karang Asih Village

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Article Info	Abstract
	The public still lacks understanding of black cumin seeds (Nigella sativa), especially regarding their bioactive content, benefits, and safety for consumption. To understand the proper use of herbal plants based on scientific evidence, the public needs research-based education. Therefore, this study aims to determine the education on the use of black cumin seeds in increasing public knowledge and measuring the basic health conditions of the people of Karang Asih Village. The technique used in this study was a quasi-experimental one-group pre-test-post-test design combined with a health survey. This online education was conducted through presentations, posters, and leaflets containing information on active metabolites, the mechanism of action of compounds, and scientific BSLT toxicity tests. To determine how well the participants understood, their knowledge was measured with a pre-test and post-test and analyzed with the Wilcoxon Signed Rank Test. Several parameters measured in the health survey to map the community's health conditions were blood pressure, postprandial blood sugar, total cholesterol, and body weight. Participants' knowledge increased significantly after education (p <0.001), with an average increase of 3.82 points. These results indicate that the public needs education on the safe use of herbs in accordance with clinical conditions. The results of this study can be used to support the idea that education-based research can increase public knowledge about the benefits and safety of black cumin seeds.

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1. INTRODUCTION

Black cumin seeds (*Nigella sativa*) have long been known as an herbal plant with various health benefits [1]. Traditionally, black cumin seeds have been used to treat various ailments, such as digestive disorders, respiratory disorders, and chronic diseases such as diabetes and hypertension [2], [3], [4], [5]. Its benefits are largely attributed to its secondary metabolite content, including alkaloids, flavonoids, saponins, and essential oils that contribute to its antioxidant, anti-inflammatory, and immunomodulatory properties [6], [7].

Although it has been widely used in traditional medicine, there are still limitations in the public's understanding of the working mechanism of the active compounds in black cumin seeds [8], [9]. Knowledge about the pharmacological potential of a natural substance needs to be supported by more in-depth research, including the identification of bioactive compounds, prediction of compound interaction targets in the body, and evaluation of toxicity. Without strong scientific information, the use of herbal plants such as black cumin seeds can lead to uncertainty in their use, especially regarding their safety and effectiveness [10], [11], [12].

One method that can be used to analyze the chemical content in black cumin seeds is metabolite profiling. Metabolite profiling is an approach used to identify and characterize

bioactive compounds in a natural material [13], [14], [15]. By knowing the metabolite content in black cumin seeds, their pharmacological benefits and potential uses in the field of health can be predicted [16], [17]. In addition, bioinformatics modeling is becoming an increasingly popular method in the study of interactions between bioactive compounds and biological targets. Through this method, it is possible to determine how the compounds in black cumin seeds work in the body and whether they have potential as natural therapeutic agents [18], [19]. In addition to its benefits, the safety aspects of consuming black cumin seeds also need to be considered. One way to assess the toxicity of a natural ingredient is through the Brine Shrimp Lethality Test (BSLT). This method is used as a preliminary test to determine the toxicity level of a natural ingredient extract using Artemia salina shrimp larvae as a test model [20], [21]. If an extract shows high toxicity levels, its use needs to be monitored more closely and studied further to ensure its safety. Conversely, if an extract shows low toxicity, the natural ingredient can be categorized as relatively safe for consumption within reasonable limits [22], [23].

This community service activity was carried out in Karang Asih Village, a village located in an area with great potential for the development of herbal agricultural products. The people of Karang Asih Village mostly depend on agriculture [24]. Most of the population depends on agriculture and has a wealth of traditional knowledge about medicinal plants. However, despite utilizing these plants in their daily lives, their understanding of bioactive content and scientific evidence regarding the benefits and safety of these plants is still very limited, based on preliminary surveys. The main problem faced is the lack of scientific information about the benefits and potential risks of consuming black cumin seeds, as well as how to use them safely. To address this problem, this research-based educational activity was conducted to provide clearer and more scientific information to the people of Karang Asih Village about black cumin seeds. Through counseling on the results of the research that has been conducted, the community will gain an understanding of the bioactive compounds in black cumin seeds, how they work in the body, and their potential benefits and safety. In addition, they will be informed about the toxicity test of black cumin seeds using the Brine Shrimp Lethality Test (BSLT), which shows that these seeds are safe for consumption within reasonable limits.

Thus, they can be wiser in utilizing the natural resources around them, especially in terms of health [25]. The importance of research-based education in introducing the benefits and safety of black cumin seeds is one of the main aspects in raising public awareness of the use of natural ingredients in everyday life. A good understanding of research results, ranging from metabolite content, compound target predictions, to toxicity tests, can help the public make wiser decisions in utilizing black cumin seeds as health supplements or natural therapies.

2. RESEARCH METHODS

2.1 Research Design

This study used a single-group pre-test and post-test quasi-experimental design, combined with a health program. The aim was to determine whether there were changes in the community's knowledge of the benefits, bioactive content, and safety of consuming black cumin seeds (*Nigella sativa*) after and before receiving educational intervention.

2.2 Research Location and Target

This research was conducted in Karang Asih village, North Cikarang sub-district, Bekasi, West Java, with respondents from the general public who attended socialization and health check-up activities. Respondents who were willing to participate in this research were people who were willing to receive education, basic health check-ups, and fill out pre-tests and post-tests.

2.3 Educational Activity Procedures

The community education activities in this sector were aimed at increasing public knowledge about plants and black cumin seeds. The education was conducted through lectures, posters, and leaflets containing information about the metabolite profile of black cumin seeds, estimates of active compounds using in silico links, and toxicity tests using the Brine Shrimp

Lethality Test (BSLT). The information was presented consecutively and in simple language so that it could be understood by people with varying levels of education.

2.4 Educational Materials

The educational materials begin with an introduction to various types of herbal plants and their uses in everyday life. Participants are then introduced to black cumin seeds as an herbal plant with potential pharmacological properties according to various studies. This includes a description of the various metabolites detected, the mechanisms of active compounds and their interactions in the body, and their health benefits. Next, participants are given educational materials on the importance of assessing the safety of herbal ingredients. This includes an explanation of the basic principles of BSLT testing, the importance of safety assessment, and how to interpret the results of the test.

2.5 Public Health Examination

In addition to educational activities, basic health examinations were also conducted. In addition to health education, basic health examinations were conducted, including blood pressure measurements, postprandial blood glucose, total cholesterol, and body weight. The results of the examination are intended to provide an overview of the participants' health status, and this information can be used during educational sessions on the wise use of herbal plants, especially among people with metabolic conditions such as hypertension, hypercholesterolemia, or diabetes, to facilitate discussion.

2.6 Pre-test and Post-test Measurements

To evaluate the effectiveness of the education provided, the data collection instruments used consisted of pre-test and post-test questionnaires. The pre-test was administered before the education began to assess the community's initial level of knowledge about the benefits, bioactive content, potential toxicity, and safety of consuming black cumin seeds. The post-test was administered after the education session was completed. The same questions were used to evaluate whether there was an increase in understanding. The questions were related to health benefits, the mechanisms of bioactive compounds, safe limits for herbal medicine consumption, and the importance of toxicity testing.

2.7 Data Analysis

All statistical analyses were performed using GraphPad Prism. Data normality was tested using the Shapiro–Wilk test on the difference variable (Δ = post-test – pre-test). Because the data were not normally distributed, the comparison of knowledge scores before and after education was analyzed using the Wilcoxon matched-pairs signed rank test (two-tailed). A p-value < 0.05 was used as the significance threshold.

3. RESULTS AND DISCUSSION

The results of the analysis show a very significant increase in the community's knowledge score after being educated about the benefits, bioactive content, and safety aspects of consuming black cumin seeds (Nigella sativa). The average pre-test score of 1.09 increased to 4.91 in the post-test, with an average difference of +3.82. This increase confirms that the educational material presented, which included metabolite profiles, active compound mechanisms, and BSLT toxicity test results, was well received by the community.

Table 1. Respondents' Pre-test and Post-test Scores

Respondent Code	Pre-test	Post-test	Difference (Δ)
R1	4	5	+1
R2	1	5	+4
R3	1	6	+5
R4	0	4	+4
R5	5	6	+1
R6	0	5	+5
R7	0	6	+6

R8	0	5	+5
R9	1	6	+5
R10	0	3	+3
R11	0	3	+3

The results of the Wilcoxon Signed Rank Test show that the difference between the pre-test and post-test is statistically significant ($p < 0.001$). This proves that the education provided is effective in improving herbal literacy and scientific understanding of the community regarding the use of black cumin. The delivery of material through presentations, leaflets, and visual media has been proven to help the community understand scientific concepts that may have been previously unfamiliar, such as bioactive compounds, pharmacological mechanisms, and the importance of toxicity testing.
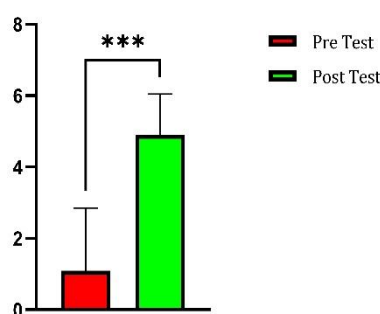

Figure 1. Bar chart comparing Pre-Test vs Post-Test

The increase in scores indicates a shift in society from a traditional understanding of medicinal herbs to a more scientific perspective, enabling more careful selection, utilization, and criticism of herbal components.

Observations of increased knowledge become even more relevant when considering simultaneous assessments of public health. Field examinations show that most participants have health conditions classified as high risk, particularly hypertension, hypercholesterolemia, and blood sugar disorders. Many participants fell into Stage 1 to Stage 2 hypertension, with the highest blood pressure recorded at 198/100 mmHg and 204/111 mmHg. In addition, the total cholesterol levels of several participants were in the range of ≥240 mg/dL, with levels of 268 mg/dL and even 296 mg/dL recorded, indicating a high risk for cardiovascular morbidity. Regarding postprandial blood sugar levels, most were within the normal range and some were classified as pre-diabetic; however, extreme levels were also recorded, such as 396 mg/dL and 267 mg/dL, indicating the possibility of uncontrolled diabetes. This condition shows that health literacy and understanding of scientific issues related to herbal use are crucial to avoid excessive or inappropriate use that can be harmful to people with metabolic disorders.

Table 2. Clinical Classification of Blood Sugar, Cholesterol, and Blood Pressure in the Community

Parameter	Category	Value Criteria	n
Postprandial Blood Glucose	Normal	<140 mg/dL	13
	Prediabetes	140–199 mg/dL	3
	Diabetes	≥200 mg/dL	2
Total Cholesterol	Normal	<200 mg/dL	4
	Borderline	200–239 mg/dL	3
	High	≥240 mg/dL	6

Blood Pressure	Normal	<120/<80	2
	Pre-hypertension	120–139 / 80–89	5
	Hypertension Stage 1	140–159 or 90–99	7
	Hypertension Stage 2	≥160 or ≥100	7

The integration of education with health services shows that the community not only receives information, but can also relate education to the state of public health. Understanding the active compounds and safety aspects of herbs becomes more constructive when participants see firsthand the results of blood pressure, blood sugar, and cholesterol tests. Community outreach also provides information on BSLT toxicity testing, which is very important in helping the community understand that herbs are not safe and still require a scientific evaluation approach before use, especially by people with chronic diseases. The community is more selective and cautious in consuming black cumin and understands the safe level of flexibility in using herbs for their health problems, after receiving increased information during educational activities.
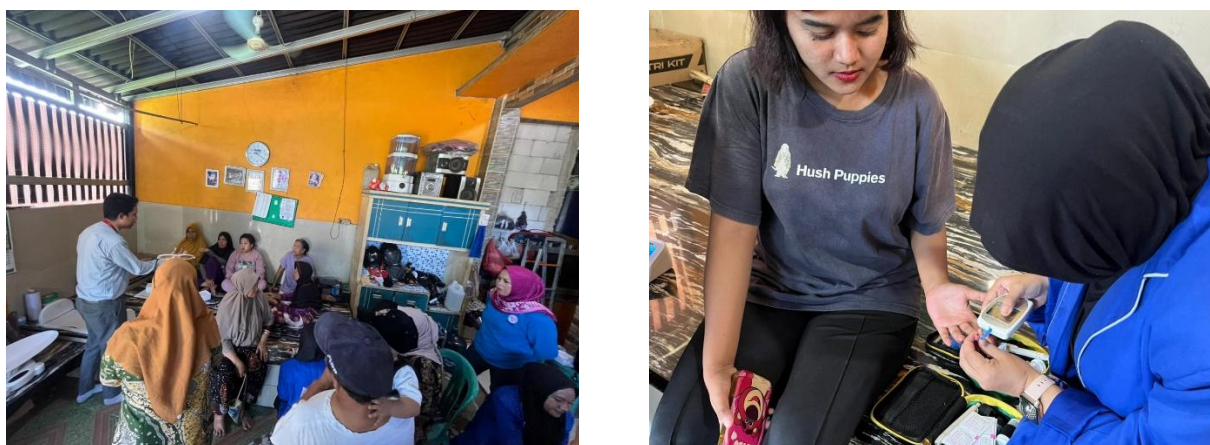

Figure 2. Public Education on Black Cumin and Health Checkups

Overall, research-based educational activities combined with public health examinations successfully improved the literacy of Karang Asih villagers in terms of herbs and scientific understanding. A significant increase in post-test scores reflects the effectiveness of the educational intervention; conversely, the results of the health check emphasize the urgency of educating the community not only about the benefits of herbs, but also about their potential toxicity and interactions with metabolic conditions. Thus, this project has successfully contributed to the empowerment of evidence-based, safe, and wise use of medicinal plants among those at high risk of chronic diseases.

4. CONCLUSIONS

Research-based education on black cumin seeds (*Nigella sativa*) has been proven effective in increasing public knowledge, as demonstrated by a significant increase between pre-test and post-test scores ($p < 0.001$). Health checks showed that many participants were at risk of hypertension, hypercholesterolemia, and blood sugar disorders, making information on the safety and use of herbs increasingly relevant. This activity contributes to improving public herbal literacy and encourages the more prudent and evidence-based use of medicinal plants.

5. ACKNOWLEDGMENTS

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